TITLE

A FABRIC COATING COMPOSITION WITH LATENT HEAT EFFECT AND A METHOD FOR FABRICATING THE SAME

BACKGROUND OF THE INVENTION

Field of Invention

The present invention relates to a method for fabricating a fabric coating composition. More specifically, the present invention relates to a method for fabricating a fabric coating composition with phase-change material microcapsules.

Description of Related Art

Heat storage (release) materials, namely phase-change materials (PCMS), undergoes physical phase changes, e.g. solid phase to liquid phase or liquid phase to solid phase, in a specific temperature range. Indeed, many materials can be regarded as PCMS in a particular temperature range. For example, in the temperature range of about 0℃, water-ice can be used as PCMS.

Two factors need to be considered for choosing PCMS, including the temperature range that PCMS is applicable and the amount of latent heat absorbed or released by PCMS during the phase change. Basically, PCMS having the proper temperature range is selected based on the environmental temperature requirements. Preferably, PCMS with larger latent heat changes are used. Since larger latent heat change allows more heat being

absorbed/released during the phase change, PCMS can stay in the phase-change temperature range for a longer period.

During the heating process, the temperature of PCMS keeps rising until the melting point is reached. During the phase changing process, the temperatures of PCMS and the surrounding environment stay constant until the phase changing process is completed. If PCMS is further heated, the temperature of PCMS will go up.

If PCMS is cooled down to the phase-change crystallization temperature, latent heat will be released. As PCMS changes from liquid phase to solid phase, the temperature of PCMS keeps constant until the phase changing process is completed. After that, the temperature of PCMS keeps decreasing if it is further cooled down.

In general, PCMS changes between liquid phase and solid phase in real applications. PCMS needs to be enclosed by a covering layer to prevent loss, especially PCMS in liquid phase. Therefore, a recent technology has been developed to wrap PCMS with microcapsules, in order not to lose liquid-phase PCMS.

PCMS can be applied in the field of textile. Ordinarily, PCMS is enclosed within microcapsules and then implanted into the fibers or coated onto the fabrics. In addition to the latent heat effect, the fabrics coated with PCMS microcapsules have to provide breathability, flexibility, washability and durability, and have resistance for temperature and pressure variation as well as resistance for chemicals, in the processing steps.

The prior microcapsules for enclosing PCMS have hydrophobic shells and are dispersed in the organic solution, so that the organic solution has to be

removed in order to obtain microcapsule powders or the microcapsule slurry. In US Patent No. 6207738, titled "FABRIC COATING COMPOSITION CONTAINING ENERGY ABSORBING PHASE CHANGE MATERIAL" and published in March 27, 2001, a fabric coating composition is disclosed including an aqueous solution having microcapsules made of paraffinic hydrocarbon PCMS, a polymeric binder, a surfactant, a dispersant, an antifoam agent and a thickener.

In US Patent No. 6503976, titled "FABRIC COATING COMPOSITION CONTAINING ENERGY ABSORBING PHASE CHANGE MATERIAL AND METHOD OF MANUFACTURING SAME" and published in January 7, 2003, the manufacturing method for the above mentioned coating composition in US6207738 is disclosed. The method comprises mixing microcapsules made of paraffinic hydrocarbon PCMS, the surfactant, the dispersant and the thickener with water to form a first dispersion solution. An antifoam agent is then added. Next, the polymeric binder, the surfactant, the dispersant, the antifoam agent and the thickener are mixed with water to form a second dispersing solution. The first and second dispersing solutions are then combined to form the coating solution.

Since the coating solution for the fabrics requires excellent dispersibility of microcapsules and the prior coating solution uses microcapsules with hydrophobic shells, it is necessary to go through complicated procedures in treating the prior coating solution, so as to obtain good dispersibility of the microcapsules.

Because the microcapsules with hydrophobic shells are used in the prior coating solution, the prior polymeric binders are either hydrophobic polymeric

binders, such as a polymer made from acrylic ester, styrene, isoprene, acrylonitrile, butadiene, vinyl acetate, vinyl chloride, vinyldiene chloride, ethylene, butylenes, propylene and chloroprene, or silicone, epoxy, polyurethane, fluorocarbons, chlorosulfonated polyethylene or chlorinated polyethylene. In order to make sure these hydrophobic polymeric binders being dispersed in the water phase, surfactants and dispersants turn out to be indispensable additives.

Although the water-phase dispersing solution is used, instead of using the organic phase dispersing solution, to prevent damages to microcapsules resulting from the organic solvent, adding surfactants and dispersants in bulk in the above two patents lengthens the process time for the coating solution. As disclosed in US Patent No. 6503976, the first dispersing solution is required to set for 1-48 hours, preferably 6-24 hours, which is very time-consuming and uneconomic. Hence, it is desirable to obtain the appropriate coating composition (solution) with simple processes, but without the addition of surfactants and dispersants.

SUMMARY OF THE INVENTION

It is appreciated that dispersibility of microcapsules in the water phase is greatly improved by using microcapsules with hydrophilic shells, instead of using prior microcapsules with hydrophobic shells.

Accordingly, the present invention provides a fabric coating solution with latent heat effects, in which microcapsules are evenly distributed without adding surfactants or dispersants.

The present invention provides a fabric coating solution with latent heat effects, which is an aqueous solution.

The present invention provides a fabric coating solution with latent heat effects, which comprises microcapsules having hydrophilic shells.

The present invention provides a method for manufacturing a fabric coating solution with latent heat effects, which produces the appropriate fabric coating solution by way of one step process. A short duration of between about 10 minutes and 6 hours is required for the fabric coating solution to set.

In the fabric coating solution of the present invention, the microcapsules for embedding PCMS have hydrophilic shells that are formed by an interfacial condensation polymerization method.

The material of the hydrophilic shell is the polymer polymerized from waterborne polyurethane in the water phase and lipophilic monomer in the organic phase. The waterborne polyurethane in the water phase is, for example, waterborne polyurethane, 2,2-bis(hydroxymethyl) propionic or its acid triethylamine salt, waterborne urethane containing sulfite salt and mixtures thereof. The lipophilic monomer in the organic phase is, for example, melamine or isocyanate salt.

The phase-change material is selected from the following group consisting of carboxylic ester, alkyl or aromatic hydrocarbons, saturated or unsaturated C6-C30 fatty acids, aliphatic alcohols, C6-C30 aliphatic amines, esters, natural or synthetic wax, halogenated hydrocarbons and mixtures thereof. Esters can be C1-C10 alkyl fatty acid esters, such as, propyl (or methyl) palmitate, methyl stearate, methyl palmitate or mixtures thereof or methyl cinnamate.

After homogenized in high speed, emulsified and heating, the PCMS enclosed microcapsules are dispersed in the water phase. Finally, a solution having 25%-55% solids is obtained. The size of the microcapsules is between about 1 micron and 10 microns. The polymeric binder and the thickener are added into the microcapsule solution and the mixture is stirred in a speed of 1000-4000rpm until the viscosity of the solution is between about 6000cps and 12000cps. The microcapsule solution is kept still for 10 minutes to 6 hours and is ready to be applied for fabric coating. If large amounts of bubbles are present in the mass production, the antifoam agent can be added as an optional choice, but not a requisite condition.

Because the microcapsules have hydrophilic shells, the microcapsules are readily distributed in the water once the microcapsules are formed. The purpose of using the polymeric binder is to affix the microcapsules to the fabrics. Generally, the polymeric binder can be silicone, epoxy resin, waterborne polyurethane, fluorocarbons, chlorosulfonated polyethylene, chlorinated polyethylene, melamine or isocynate ammonium. The amount of the polymeric binder is about 1%-90% relative to the amount of microcapsules.

The purpose of using the thickener is to make the coating solution more viscous, so that the coating solution stay on the fabrics and will not permeate through the textile. Preferably, the thickener is selected from the following group consisting of poly acrylic acid, cellulose ester and its derivatives, polyethylene alcohol, other well-known thickening agents and mixtures thereof. The amount of the thickener is about 2%-12% relative to the amount of microcapsules. The antifoam agent can be fatty acid salts, sulfonates, waterborne dispersible silicon oil or waterborne dispersible silicon powder. The amount of the antifoam agent

is about 0%-1% of the amount of the coating solution. The water content in the coating solution is between about about 30% and 70%.

The present invention provides a fabric coating solution with latent heat effect. Without additionally adding dispersants and surfactants into the solution, the coating solution is obtained through one single process of mixing and stirring. The coating solution of the present invention is allowed to set for between about 10 minutes and 6 hours, prior to application. Compared with the prior art coating solution, the coating solution obtained from the method of the present invention can reduce costs and greatly save time.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation for the fabric coating solution and the method for manufacturing the same in the present invention.

Example 1

1g of sodium isocynate is added as the polymeric binder into 100g of microcapsule aqueous solution having 40% PCMS enclosed hydrophilic microcapsules. 3.5g of polyethylene alcohol is then added into the mixture, followed by stirring at a speed of 1000rpm until the viscosity of the solution is larger than 8000cps. The solution is allowed to set for 20 minutes and the resulting fabric coating solution has a water-content of 57.4%.

Example 2

36g of waterborne polyurethane/melamine resin is added as the polymeric binder into 100g of microcapsule aqueous solution having 40% PCMS enclosed hydrophilic microcapsules. 1.48g of cellulose ester is then added into the mixture, followed by stirring at a speed of 3000rpm until the viscosity of the solution is larger than 6500cps. The solution is allowed to set for 2 hours and the resulting fabric coating solution has a water-content of 43.6%.

Example 3

44g of waterborne polyurethane/isocyanate is added as the polymeric binder into 100g of microcapsule aqueous solution having 50% PCMS enclosed hydrophilic microcapsules. 1.48g of cellulose ester is then added into the mixture, followed by stirring at a speed of 2000rpm until the viscosity of the solution is larger than 7000cps. The solution is allowed to set for 4 hours and the resulting fabric coating solution has a water content of 34.3%.

Example 4

1g of isocyanate is added as the polymeric binder into 100g of microcapsule aqueous solution having 30% PCMS enclosed hydrophilic microcapsules. 3.5g of polyethylene alcohol is then added into the mixture, followed by stirring at a speed of 2000rpm until the viscosity of the solution is larger than 8000cps. The solution is allowed to set for 20 minutes and the resulting fabric coating solution has a water-content of 67%.

Example 5

400g of waterborne polyurethane is added as the polymeric binder into 5000g of microcapsule aqueous solution having 40% PCMS enclosed hydrophilic microcapsules. 80g of cellulose ester and 5.5g of waterborne dispersible silicon powder (as the antifoam agent) are then added into the mixture, followed by stirring at a speed of 2000rpm until the viscosity of the solution is larger than 8000cps. The solution is allowed to set for 6 hours and the resulting fabric coating solution has a water content of 54.6%.

In general, no antifoam agent is required for small-scale production. Only in the mass production, the antifoam agent can be added as an optional choice. According to the embodiment, the amount of the antifoam agent is about 0.1% in weight.

It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.